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US 5782026 A US 5494445 A

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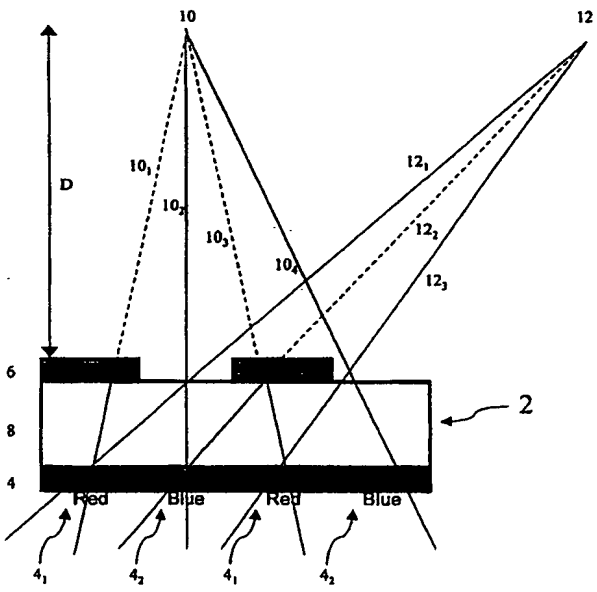
(54) Abstract Title
Display device

(57) A display device 2 comprises a mask layer 6 having at least one opening and an image layer 4. Image layer 4 has a first component comprising a first image 4_1 and a second component comprising a second image 4_2 each component arranged in alignment with the at least one opening of mask layer 6, mask layer 6 and image layer 4 being separated at a distance such that the image seen by a viewer of the device 2 depends on the viewing angle. Mask 6 preferably comprises a grid-like structure of a plurality of elongate substantially parallel opaque regions separated by transparent regions. The images may each be formed from a number of elongate substantially parallel inter-spaced image regions, the width of each being substantially equal to the width of the transparent regions of the mask 6. A transparent spacing layer 8 may be provided to maintain the spacing of mask 6 and image layer 4 and is preferably of constant or variable thickness and formed of polyethylene terephthalate. The first and second images may be different, and the mask 6 may have the same image as the first or second images. A second image layer may be provided on the reverse of the device 2 (Fig 3) with a second mask layer also, arranged in the same manner as the first side. The invention is intended for use as an advertising placard.

Figure 1.



Display illuminated from this side.

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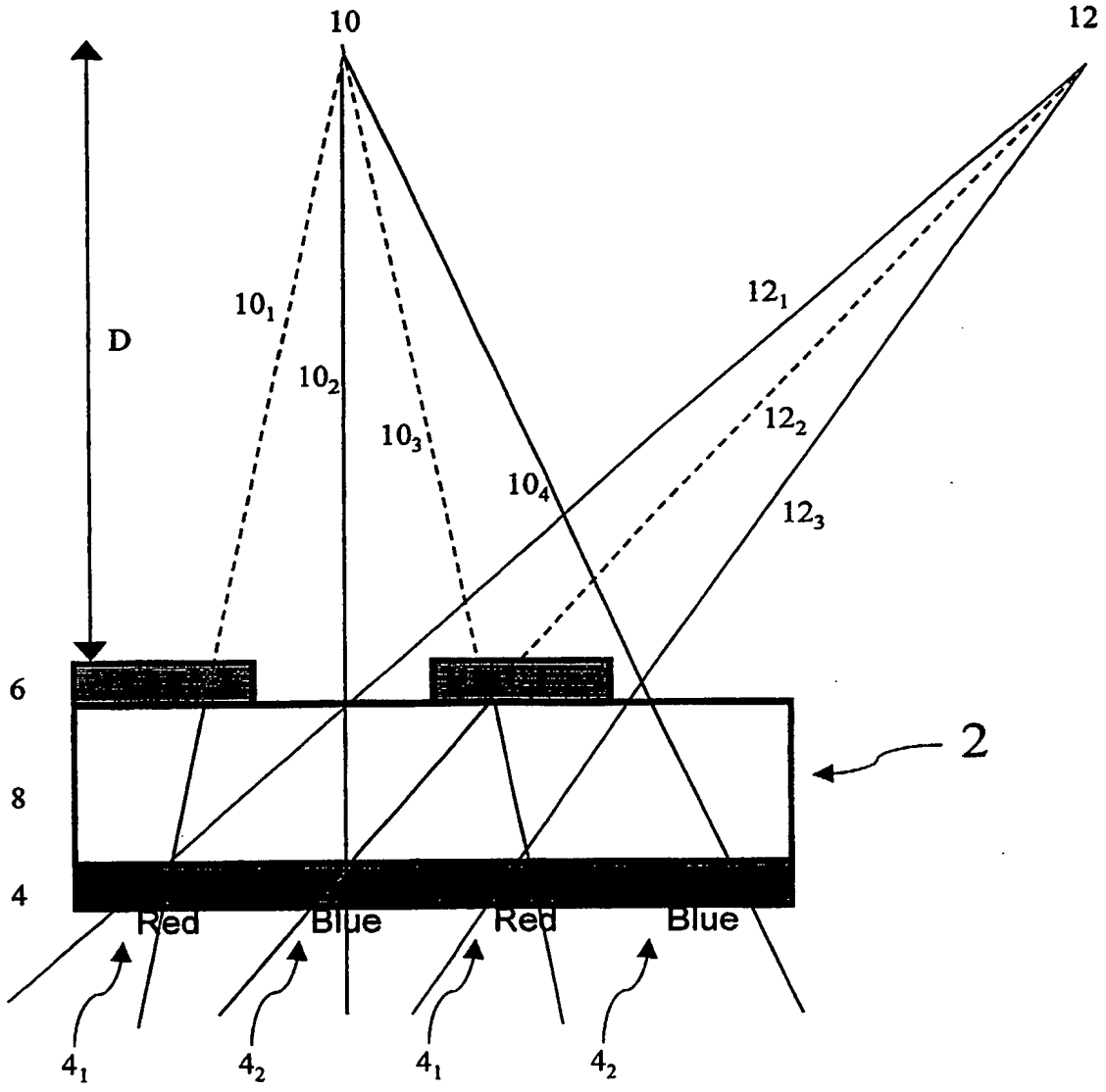
Figure 1.



Display illuminated from this side.

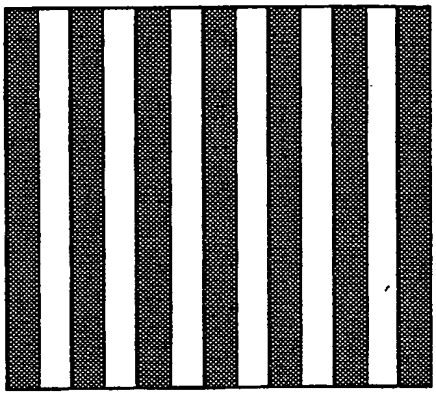


Fig. 2A

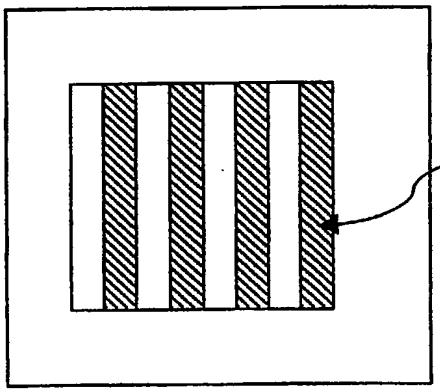


Fig. 2B

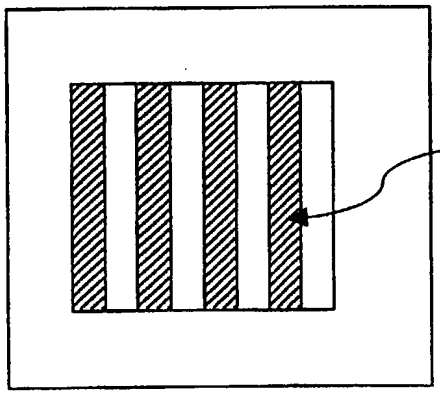
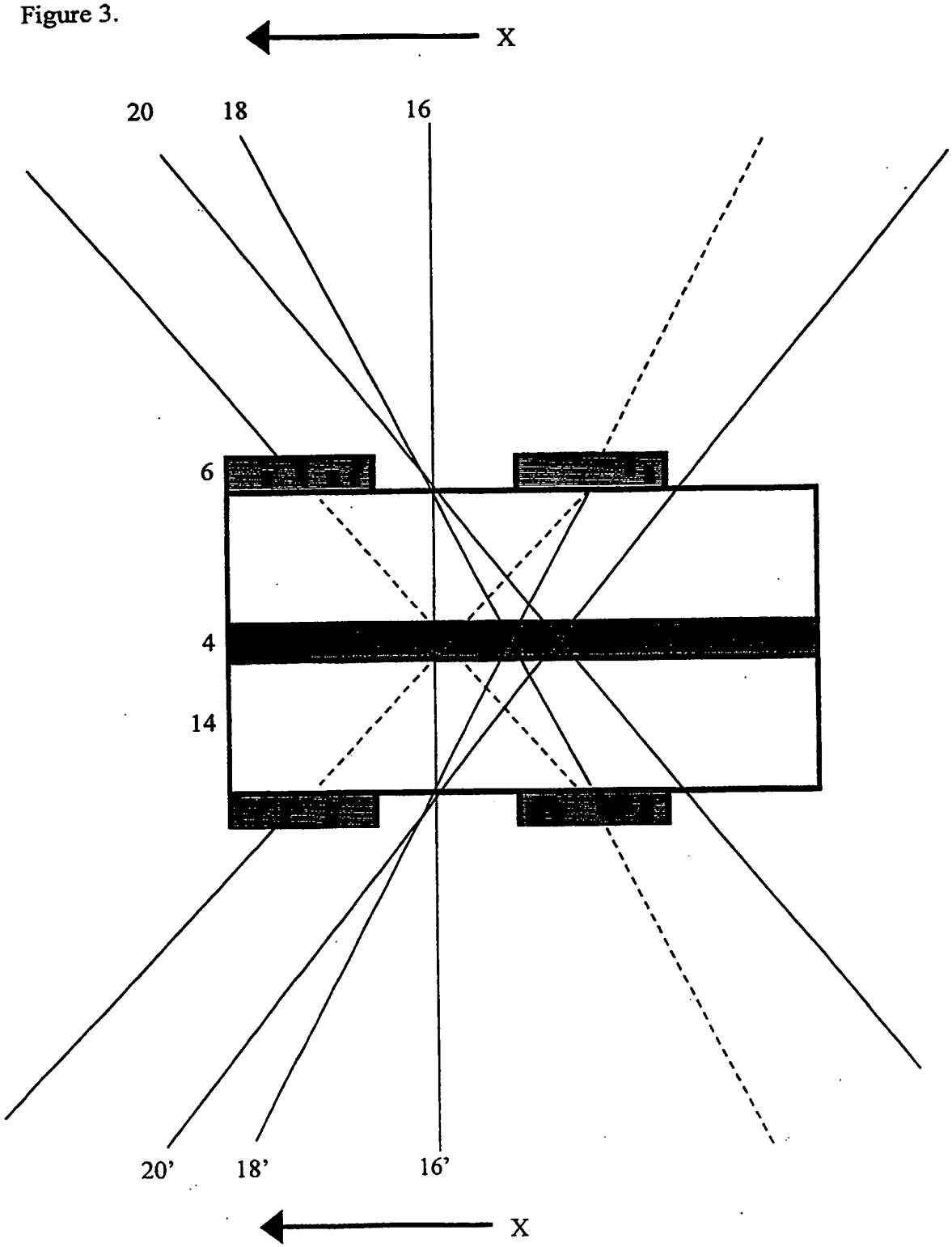


Fig. 2C

Figure 3.



(Display illuminated from either side.)

A Display Device

Field of the Invention

The present invention relates to a display device and in particular to a display device suitable for use, for example, as an advertising placard.

Background of the Invention

Display devices exist in which the image seen by a viewer on the device is dependent on the angle from which the device is viewed. These are useful since the effect of a changing image can be striking to a viewer in, amongst others, the field of advertising where it is important to catch a viewer's attention. One way in which the effect of a changing image can be achieved is with the use of a lenticular lens sheet arranged in front of a strip-composite image layer. The image layer is made up of two or more images (usually photographs) interlaced in narrow strips. The lens sheet is usually formed from a sheet of plastic on which is molded a series of cylindrical lenses in parallel rib-like rows adjacent to each other. Each of the lenses, called a lenticule, has a focal length equal to the thickness of the clear plastic sheet on which it is molded. The sheet is arranged so that each of the lenses runs parallel to and corresponds to one strip from each of the interlaced two or more photographs. Each lenticule magnifies a part of the image placed behind it but since each part will have a strip from each of the at least two images, the image that is magnified is dependent on the angle from which the display is viewed. Therefore, different images are projected in dependence on the viewing angle of the display device.

A problem with such devices is that the lens sheet adds complexity and cost to the display device. The images and the lens are separate components that have to be combined securely together in some fashion, and aligned exactly, without compromising the optics or physical quality of the final element. The cost of the lens sheet is substantial in comparison to the cost of the image layer. In addition there is a strong desire to make the component strips of image very

narrow to prevent the viewer from detecting their presence and to create the illusion of a 3D image and this is not easily achieved.

Finally, it is also desired that the display device may be composed of a conventional image having display elements within it in which the image seen by a viewer of the elements is dependent on the angle from which the device is viewed. For example, a face may be represented with eyes that look open when viewed from one direction and closed when viewed from another. Lenticular elements do not allow convenient combinations of this type.

An alternative arrangement uses holographic displays of the image to produce a similar effect. In this case, the cost of manufacture and materials used to generate the hologram are substantial. The production is difficult and the viewing often requires special lighting arrangements and viewing angles to enable the viewing effects to be appreciated. As discussed above with respect to the lenticular screen display, holographic display elements do not conveniently allow combinations of holographic images with ordinary printed images in the same display.

Problem to be solved by the Invention

There is a need for a display device in which the image seen by a viewer is dependent on the angle from which the device is viewed which is cheap, easy to make and robust and does not suffer from the problems mentioned above. There is also a need for a display device that enables creative combinations of ordinary printed images with display elements in which the image seen by a viewer of the elements is dependent on the angle from which they are viewed.

Summary of the Invention

According to a first aspect of the present invention, there is provided a display device, comprising a mask layer having at least one opening, an image layer having a first component comprising a first image and a second component comprising a second image each arranged in alignment with the at least one opening of the mask layer, the mask layer and the image display layer being

separated from each other at a distance such that the image seen by a viewer of the device is dependent on the viewing angle. The first and second images of the image layer may be the same or different.

Preferably, the mask comprises a plurality of elongate substantially parallel opaque regions separated by a corresponding number of elongate substantially parallel transparent regions and the first and second images are each formed from a plurality of elongate substantially parallel inter-spaced image regions. Alternatively, the mask may be made up of an array of any other suitable shape so that movement in different directions relative to the display device will cause the image changing effect to occur.

The optimum distance between the mask layer and the image layer may depend on any of the width of the component strips, the disposition of the three (or more) image components, whether they are written on separate supports or a single support and the viewing distance. As a primary purpose of the display device is for use in an advertising placard, it is not necessary that the strips are sufficiently narrow that they cannot be resolved. In some contexts, visual detection of the strips is not objectionable although it is desirable that they should be imperceptible.

In one example of the display device according to the present invention, the width of each image strip is less than the width of the at least one opening in the mask layer.

According to a second aspect of the present invention, there is provided a display device, comprising:

an image layer having a first component forming a first image and a second component forming a second image;

first and second transparent spacer layers formed respectively on an upper and lower surface of the image layer;

a first mask layer having at least one opening formed on the first spacer layer;

a second mask layer formed on the second spacer layer having at least one opening corresponding to the at least one opening of the first mask layer;

the image components each being arranged in alignment with the at least one opening of the respective the mask layer, such that on either side of the display device the image seen by a viewer of the device is dependent on the viewing angle.

Advantageous Effect of the Invention

The first aspect of the present invention provides a display device in which the image seen by a viewer is dependent on the angle from which the device is viewed. In contrast to conventional multi-image display devices which rely on lenticular lens-sheets, the device of the present invention is easier to produce and also cheaper. The same advantages are present over other conventional forms of multi-image display devices such as holographic displays.

The second aspect of the present invention has all the benefits of the first aspect. In addition to these, it enables the display device to be viewed from both sides making it particularly suitable for use in an environment where this is likely to occur. Examples include use as an advertising placard in a station concourse or by a roadside or any situation in which passers-by are likely to approach the display device from both sides.

Brief Description of the Drawings

Examples of the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 shows a section through a first example of a display device according to the present invention;

Figures 2A to 2C show plan views of the component layers of the display device of Figure 1; and,

Figure 3 shows a section through a second example of a display device according to the present invention.

Detailed Description of the Invention

Figure 1 shows a first example of a display device according to the present invention. The device 2 has an image layer 4 and a mask layer 6 arranged at a predetermined separation from each other. In this example a spacing layer 8, provided by a single support, maintains the mask layer 6 and image layer 4 at a layer separation S. The support may be formed from a transparent medium such as poly(ethylene terephthalate), cellulose acetate or glass, as long as it is capable or made capable of receiving the printed images. Alternatively, the images can be written onto separate supports and the distance adjusted by mounting the sheets with the desired spacings or alternatively it may simply be a spacing provided to ensure that the device functions as described below. The mask layer is made up of a plurality of parallel opaque or translucent strips separated by transparent strips. In this example, the image layer is made up of alternate red and blue strips 4_1 and 4_2 of a thickness (width) corresponding to the width of the strips in the mask layer, the image layer and the mask layer being arranged in alignment with each other. That is to say, the image layer shows an image formed of parallel strips of the red and blue so that when viewed from a position along a perpendicular line from the major surface of the display device, one of the sets of image strips (red in this case) is completely hidden from the viewer whereas the other set (blue in this case) is clearly visible.

A viewer will typically be positioned at a location remote from the display device separated therefrom by a perpendicular distance D substantially greater than the layer separation S. If the viewer is at the position identified by the point 10 in Figure 1, the blue image will be seen since strips of the mask substantially block or alter the viewer's perception of the red image. This is shown by the rays 10_1 to 10_4. Rays 10_3 and 10_1 are unable to penetrate (or are substantially altered by) the strips of the mask and cannot reach a viewer's eye, whereas rays 10_2 and 10_4 are able to do so projecting an image of the components 4_2 on the user's eye. The viewer therefore sees a blue image. If however, the viewer moves to position 12 and views the display device a red image is seen since rays 12_1 and 12_3 are able to penetrate the mask projecting an image of the components 4_1 on the user's eye, whereas ray 12_2 is blocked by the strips of the mask. In other words, from a first

viewing angle a viewer sees the first (red) image through the mask and from a second different viewing angle a viewer sees the second (blue) image through the mask

The distance S between the mask layer and the image layer determines the optimum distance D at which a viewer must be positioned to experience the image changing effect. Accordingly, this is optionally variable so that the display can be set for operation in any particular environment. For example, if the display is to be used as an advertising placard in a railway station, the distance between a viewer and the display is likely to be large whereas if it is to be used as a floor-mounted advertisement the distance is much smaller. Therefore, the distance S is set to an appropriate value for use of the device in each of these situations.

In this example, the difference between the image components 4_1 and 4_2 is the colour such that the colour of the image that a viewer sees is dependent on the angle from which the display device is viewed. The invention is not limited to this and in fact any two images could be arranged in the strip formation so that the image seen by a user is dependent on the angle from which the display device is viewed. It is also possible that parts of the image are written so that they are visible regardless of the viewing angle by writing them into all of the components or even on the mask itself. Sufficient illumination of the image is achieved by incident light reflected from the display device although it is possible to provide an additional light source. This may be by back-lighting the display. However, it is possible that the display could be lit from the front as long as a suitably reflective background is placed behind the device to reflect the incident light back to the viewer.

Figures 2A to 2C show plan views of the component layers of the display device of Figure 1. Figure 2A shows a plan view of the mask layer. The layer is formed by a plurality of parallel translucent lines formed at a predetermined separation from each other to line up with the image layer below. Figure 2B shows a first component of the image, say components 4_1 from Figure 1, and Figure 2C shows the second component, components 4_2 in this case. As can be seen, spaces in the image shown in Figure 2B coincide with the image portions of

the image shown in Figure 2C. As mentioned above, it is not essential that the mask is a plurality of elongate parallel regions. It is however necessary that there is alignment between the image portions of the image layer and the regions of the mask layer of the display device so that, from a first viewing angle one set of image regions are covered by the mask and from another viewing angle a different set of image regions are overlaid by the mask. So long as this requirement is met, any suitable shape could be used to make up the mask.

It is also possible that each of the image portions is in fact composed of two or more adjacent image strips. As the viewing angle changes, a viewer will see a combined image made up of some of the strips initially concealed behind the mask and some of the strips initially exposed. The relative proportions of the two types of image strips seen by the viewer will vary with viewing angle. Therefore, viewer will perceive more image changes as the viewing angle is changed.

There are situations in which it is desirable for a display device to be viewable from both the front and back. For example, in a well-lit thoroughfare in a shopping mall or airport there might be a free-standing display, rather than a backlit wall-display. It is clearly desirable that the display device should be viewable from both the front and back.

Figure 3 shows a section through a second example of a display device according to the present invention that is suitable for use in such a situation. In this case the image-changing effect due to the positioning and alignment of the mask layer is the same as in the example described above with reference to Figure 1. In addition, a further spacing layer 14 is provided on the reverse side of the image layer 4. This enables the images contained within the image layer 4 to be viewed from both sides of the display device. This makes the device particularly suitable for use, for example, as an advertising placard in a place where viewers move around and are likely to view the device from both sides.

In the example shown in Figure 3, three images are viewed as the viewing position moves in direction X from 16 to 20 (or 16' to 20'). At position 16, the blue image will be seen corresponding to position 10 in Figure 1. At position 20, the red image will be seen corresponding to position 12 in Figure 1. However,

there is an intermediate position, 18 at which the image of the mask on the reverse side of the image layer will be seen. At this position neither the red image nor the blue image will be visible. Rather a uniform black image will be seen, the image being a superposition of the two mask layers.

To create a display device according to the present invention it is important to ensure registration (alignment) between the mask(s) and the image layer. This can be achieved using conventional printing techniques or any other suitable method.

Claims:

1. A display device, comprising:
a first mask layer having at least one opening;
an image layer having a first component comprising a first image and a second component comprising a second image each component arranged in alignment with the at least one opening of the mask layer, the mask layer and the image layer being separated from each other at a distance such that the image seen by a viewer of the device is dependent on the viewing angle.

2. A display device according to claim 1, in which the mask comprises a plurality of elongate substantially parallel opaque regions separated by a corresponding number of elongate substantially parallel transparent regions.

3. A display device according to claim 2, in which the first and second images are each formed from a plurality of elongate substantially parallel inter-spaced image regions.

4. A display device according to claim 3, in which the width of the elongate substantially parallel inter-spaced image regions is substantially equal to the width of the substantially parallel opaque regions of the mask layer.

5. A display device according to any preceding claim, in which the mask layer and the image layer are maintained at a separation from each other by, for example, a transparent spacing layer.

6. A display device according to claim 5, in which the thickness of the spacing layer is variable.

7. A display device according to claim 5, in which the spacing layer provided by a sheet of poly(ethylene terephthalate).

8. A display device according to any preceding claim, in which the first image and the second image are different.

9. A display device according to any preceding claim, in which the mask is the same as at least one of the first and second images.

10. A display device according to any preceding claim, further comprising a second mask layer provided on a reverse side of the device, the second mask layer being arranged at a separation from the image layer and having at least one opening aligned with the at least one opening of the first mask layer such that the display device can be viewed from both sides.

11. A display device, comprising:
an image layer having a first component comprising a first image and a second component comprising a second image;
first and second spacer layers formed respectively on an upper and lower surface of the image layer;
a first mask layer having at least one opening formed on the first spacer layer;
a second mask layer formed on the second spacer layer having at least one opening corresponding to the at least one opening of the first mask layer;
the image components each being arranged in alignment with the at least one opening of the respective the mask layer, such that on either side of the display device the image seen by a viewer of the device is dependent on the viewing angle.

12. An advertising placard comprising a display device according to any of claims 1 to 11.

INVESTOR IN PEOPLE

Application No:	GB 0104463.5	**Examiner:**	Andrew Hole
Claims searched:	1 to 12	**Date of search:**	20 June 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): None

Int Cl (Ed.7): G09F 19/14

Other: Online: WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	US 5782026	(CAPIE) See whole document.	1 to 11
X	US 5494445	(SEKIGUCHI et al.) See especially Fig 124 and column 12, lines 7 to 22 & column 33, lines 51 to 65.	1 to 11

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.